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RESEARCH ON MULTIPARAMETER STOCHASTIC PROCESSES

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FINAL REPORT

E. Wong

1 September 1978 - 31 August 1981

U.S. Army Research Office

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Technical Achievements

During the period of this grant, a number of problems on stochastic processes were studied. The principal achievements were:

- (1) The development of a theory of set-parametered martingales and an associated theory of stochastic integration.
- (2) The discovery of a class of nonlinear filtering problems for which explicit solutions can be obtained.

The theory of stochastic integration for stochastic processes with a single parameter is now largely complete, thanks to the work of Kunita-Walanabe and the efforts of the Strassbourg school under P.A. Meyer. It is now universally recognized that the theory of stochastic integration is inherently in theory of martingales. Beginning in 1974 with the work of Wong-Zakai and Cairoli-Walsh, a theory of martingales and integration for multiparameter processes was initiated. However, the theory is far from complete, and in a number of significant aspects its state of development is unsatisfactory. While for some time we have thought that in the case of multiparameter processes martingales would be more appropriately parametered by sets rather than points, this idea did not lend to any significant results until the dissertation of B. Hajek. With that work and the subsequent papers by Hajek and Wong, a natural framework for stochastic integration with output to random set functions has been established. The results to date have elucidated the general problem of representing likelihood ratios as functionals of the observed process, and as such are likely to find important applications.

In part as a result of the work on set-parametered martingales, we have reexamined the use of multiple Wiener integrals in representing

likelihood ratio. This investigation has led to the discovery of a class of nonlinear filters for which more or less has explicit solution can be found. The practicability of the results is currently being studied.

Publications

- [1] E. Wong and M. Zakai, "Weak Martingales and Stochastic Integrals in the Plane," The Annals of Probability, Vol. 4, No. 4, pp. 570-586, 1976.
- [2] E. Wong and M. Zakai, "An Extension of Stochastic Integrals in the Plane," The Annals of Probability, Vol. 4, pp. 770-778, 1977.
- [3] E. Wong and M. Zakai, "The Sample Function Continuity of Stochastic Integrals in the Plane," The Annals of Probability, Vol. 5, pp. 1024-1027, 1977.
- [4] E. Wong and M. Zakai, "Differentiation Formulas for Stochastic Integrals in the Plane," Stochastic Processes and Their Applications, Vol. 6, pp. 339-349, 1978.
- [5] E. Wong and M. Zakai, "Likelihood Ratios and Transformation of Probability Associated with Two-Parameter Wiener Processes," Zeitschrift fur Wahrscheinlichkeitstheorie u. verw. Geb., Vol. 40, pp. 283-308, 1977.
- [6] E. Wong and E.T. Tsui, "One-Sided Recursive Filters for Two-Dimensional Random Fields," IEEE Trans. on Information Theory, Vol. IT-23, pp. 633-637, 1977.
- [7] E. Wong, "Recursive Casual Linear Filtering for Two-Dimensional Random Fields," IEEE Trans. Information Theory, Vol. 24, pp. 50-59, 1978.

- [8] B. Hajek and E. Wong, "Set-Parametered Martingales and Multiple Stochastic Integration," Proceedings of the 1980 London Math. Society Symposium in Stochastic Integration, 1980.
- [9] B. Hajek and E. Wong, "Representation and Transformation of Two-Parameter Martingales Under a Change of Measure," Z. Wahrscheinlichkeitstheorie verw. Gebiete, Vol. 54, pp. 313-330, 1980.
- [10] E. Wong, "Explicit Solutions to a Class of Nonlinear Filtering Problems," Stochastics, Vol. 5, pp. 311-321, 1981.

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